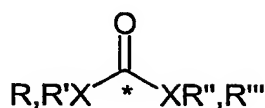


What is claimed is:

1. A method for labeling synthesis of phosgene, comprising:
  - 5 (a) providing a UV reactor assembly comprising a high pressure reaction chamber and a UV light source, wherein the high pressure reaction chamber having a window facing the concave mirror, a first gas inlet and a second gas inlet,
  - (b) providing a  $\text{Cl}_2$  gas to be labeled,
  - (c) introducing a carbon-isotope monoxide enriched gas-mixture into the reaction  
10 chamber of the UV reactor assembly via the first gas inlet,
  - (d) introducing said  $\text{Cl}_2$  gas into the reaction chamber via the second gas inlet,
  - (e) turning on the UV light source and waiting for a predetermined time while the labeling synthesis occur, and
  - (f) removing the labeled phosgene from the reaction chamber.
- 15 2. A method of claim 1, wherein the carbon-isotope monoxide enriched gas-mixture is produced by a method comprising:
  - (a) providing carbon-isotope dioxide in a suitable carrier gas,
  - (b) converting carbon-isotope dioxide to carbon-isotope monoxide by introducing  
20 said gas mixture in a reactor device,
  - (c) trapping carbon-isotope monoxide in a carbon monoxide trapping device, wherein carbon-isotope monoxide is trapped but not said carrier gas, and
  - (d) releasing said trapped carbon-isotope monoxide from said trapping device in a well defined micro-plug, whereby a volume of carbon-isotope monoxide enriched  
25 gas-mixture is achieved.
3. A method of claim 1, wherein the carbon-isotope is  $^{11}\text{C}$ ,  $^{13}\text{C}$ , or  $^{14}\text{C}$ .
4. A method of claim 1, wherein the carbon-isotope is  $^{11}\text{C}$ .
- 30 5. A method of claim 1, wherein the UV light source is a UV lamp.

6. A method of claim 1, wherein the step of waiting a predetermined time comprises stirring in the reaction chamber to enhance the labeling synthesis.
7. A method of claim 7, wherein the step of waiting a predetermined time further  
5 comprises adjusting the temperature of the reaction chamber so that the labeling synthesis is enhanced.
8. A system for labeling synthesis, comprising:
- (a) a UV reactor assembly comprising a high pressure reaction chamber,  
10 (b) a UV light source,  
wherein the high pressure reaction chamber having a window facing the UV light source, a first gas inlet and a second gas inlet in a top and/or bottom surface thereof, wherein the UV light beam enters the window of the reaction chamber.
9. A system of claim 8, further comprising a concave mirror facing the window of  
15 the high pressure reaction chamber, so that the concave mirror can focus the UV light beam from the UV light source.
10. A system of claim 8, further comprising a motor, a magnet, and a magnetic  
20 stirring bar inside the reaction chamber.
11. A system of claim 8, wherein the window is a sapphire window.
12. A system of claim 9, further comprising a protective housing and a bench where  
25 the reaction chamber, UV lamp and the concave mirror can be mounted.
13. A method for radio-labeling comprising reaction of carbon-isotope phosgen synthesized according method of claim 1 with a compound of formula (I) and a compound of formula (II):
- 30  $RR'XH$  (I)  
 $R''R'''XH$  (II),  
to give a labeled compound of formula (III):



(III)

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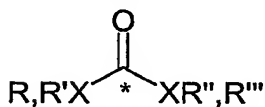
wherein X is selected from N, O, S or Se, and R, R', R'' and R''' are independently void, H, linear or cyclic lower alkyl or substituted alkyl, aryl or substituted aryl.

14. A method of claim 13, wherein R, R', R'' and R''' may contain carbonyl,  
10 hydroxy, thiol, halogen, nitrile, isonitrile, cyanate, isocyanate, thiocyanate, isothiocyanate functional groups, carbon-carbon double bonds or carbon-carbon triple bonds.

15. A method of claim 13, wherein R, R', R'', R''' may be connected in the case of  
15 ring closure reactions.

16. A method of claim 13, wherein the carbon-isotope monoxide is [ $^{11}\text{C}$ ] monoxide.

17. A carbon-isotope labeled compound of formula (III) synthesized according to a  
20 method of claim 13,



(III)

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wherein X is selected from N, O, S or Se, and R, R', R'' and R''' are independently void, H, linear or cyclic lower alkyl or substituted alkyl, aryl or substituted aryl.

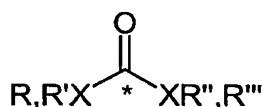
18. A carbon-isotope labeled compound of claim 17, wherein R, R', R'' and R''' may contain carbonyl, hydroxy, thiol, halogen, nitrile, isonitrile, cyanate, isocyanate, thiocyanate, isothiocyanate functional groups, carbon-carbon double bonds or carbon-carbon triple bonds.

5

19. A carbon-isotope labeled compound of claim 17, wherein R, R', R'', R''' may be connected in the case of ring closure reactions.

20. A kit for PET study comprising a carbon-isotope labeled compound of formula (III),

10



15

wherein X is selected from N, O, S or Se, and R, R', R'' and R''' are independently void, H, linear or cyclic lower alkyl or substituted alkyl, aryl or substituted aryl.

21. A kit of claim 20, further comprising radioprotectant, antimicrobial preservative, pH-adjusting agent or filler.

20

22. A kit of claim 21, wherein the radioprotectant is selected from ascorbic acid, para-aminobenzoic acid, gentisic acid and salts thereof.

25

23. A kit of claim 21, wherein the antimicrobial preservative is selected from the parabens, benzyl alcohol, phenol, cresol, cetrimide and thiomersal.

24. A kit of claim 21, wherein the pH-adjusting agent is a pharmaceutically acceptable buffer or a pharmaceutically acceptable base, or mixtures thereof.

30

25. A kit of claim 21, wherein the filler is inorganic salts, water soluble sugars or sugar alcohols.